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ABSTRACT

The importance of information systems management to institutional research efforts of colleges and universities is discussed. The goal of information system management is to make an institution's information system more consistent, efficient, and informative. Each of the different functions of the university, such as admissions and registration, has data requirements and needs to be part of one system rather than separate entities. The first task in converting from an application to a data base system is to identify existing subsystems and to establish priorities for analysis. A data element dictionary is a product of analyzing information forms and data elements of an institution. A file description and data definition page from the University of South Florida Data Dictionary/Directory are appended as illustration. The final step in analyzing existing systems is to inventory reports and to link data elements to reports. Since applications data files often contain large amounts of blank space for unmaintained data or for expansion, conversion to a data base or a conglomeration of files, programs, and resources, uniform standards must be applied across all data systems. Input controls, data maintenance, and data access functions are outlined. (SW)

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Information Systems Management:

A Function for Institutional Research

by

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Mary Corcoran
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(Editor, AIR Forum Publications)

Information Systems Management: A Function for Institutional Research

ABSTRACT

Out of the chaos of the information explosion set off by the introduction of the computer to higher education has come a new function: institutional information systems management. Consideration of the duties, skills, and tools associated with this function leads to the conclusion that information systems management is logically and extension of institutional research.

INFORMATION SYSTEMS MANAGEMENT: A FUNCTION FOR INSTITUTIONAL RESEARCH

The age of the computer has brought with it an explosive growth in the rate at which data are generated and stored. Until recently, the philosophy of computer system design encouraged attempts to store every conceivable data item just in case it might be needed at some future date. This occurred because there never seemed to be enough time for enhancments. Existing systems became cast in concrete as soon as the design team started a new project. As a result, institutions find themselves with millions of bits of data which are very often redundent, inconsistent, poorly documented and difficult to retrieve.

Information Systems

Out of this chaos has grown an organizational function--information systems management. An information system is made up not only of data but of people, machines and procedures (Rosove, 1967). Vickey (1973) gives the following definition:

> An information system is an organization of people, materials and machines that serves to facilitate the transfer of information from one person to another. Its function is social; to aid human communication. (p.1)

McCorkle (1977) expands upon this by adding that a management information system includes "subjective judgements of informed persons" (p.3).

Environment

Much of the institutional research literature on information systems deals with fitting the system to the style of governance (Adams, 1977, Arns, 1979, Heydinger and Norris, 1979, Jenny, 1978, Parker and Gardner, 1978, Sibley, 1975). Schmidtlein (1975) clearly delineates two modes of higher education governance. One is the Incremental/Remedial strategy which is characterized by decentralized decision making, an empirical, reactive mode

of operation, autonomy and pluralism. This is the collegial model which views the institution as a "community of status equals" (Goodrich, 1971, p.69). The other model identified by Schmidtlein (1975) is the Comprehensive/Prescriptive strategy characterized by centralized decision making, comprehensive planning, goal directed allocation of resources and evaluation of results.

Each of these models requires a different type of reporting system but both require information in some form. That information must be credible (Sibley, 1975, p.15) and timely (Parker and Gardner, 1978, p.18, Sandin, 1977, p. 20-21). The proponents of collegiality advise that the information be made readily available to the diverse policy groups within the institution (Heim, 1973, p.102). If policy is to be set by committees, those committees need both information and assistance in using that information. The information system must be flexible (Parker and Gardner, 1978, p.10) since committees change often. The information must be stated simply since committees are rarely peopled by experts (Heim, 1973, p.102).

Management information, on the other hand, should deal in patterns and aggregates (Sibley, 1975, Trotter and Creet, 1978), since a manager's scarest resource is time. Management information can make use of technically sophisticated techniques such as statistical analysis and models (Cheit, 1977, Lasher, 1978) provided the manager is willing to learn to understand and trust the model.

Information is not only required at policy levels, it is even more important at operational levels (Rosove, 1967, Schmidtlein, 1977, p.34). In fact, it is often operational data together with data concerning the external environment which are aggregated into management information, (Robinson, 1978). It is at the operational level, however, that data problems first arise due to faulty systems philosophy, poor communication, and lack of proper controls.

Application Programming - The Traditional Approach

These problems have been brought about, in part, by traditional computer system design methods. Finance, personnel/payroll, admissions, registration are each treated as a self-contained computer system. They don't share data; they collect, code and report their own. The programs 'own' the data. Some passing of data does occur, but, usually copies of data files are passed from one system to another, rather than having the second system access the original data. Alternatively, 'pick-off' data sets containing subsets of system files are created and passed to another system. The first method results in much duplication of information. The second not only creates duplication but requires extra programming whenever changes are made to the originating system.

Since each system is collecting its own data, duplication exists in the collection process. Also, since each system defines its own files, the same data element can have different physical description, different coding scheme, and often, a different name, one that is unrecognizable to the user of another system.

The administrator who controls the flow of information into the computer is presumed to be familiar with his or her own data, so there seems to be little need for extensive user documentation. The responsible administrator typically has a loose leaf notebook with pertinent codes and notes, but rarely knows with any certainty all that resides in the files nor how it got there. This is especially true after a turnover or two in personnel. As systems are patched, changed or expanded inconsistencies start to creep into the data. Because of the lack of coherent documentation, these are often found only by accident, and then are extremely difficult to explain and correct.

Data Base Systems - The Modern Approach

Appleton (1977, p.87) states that "A data base is a logical construct,

not necessarily a physical one." It defines the relationships among the tasks performed by organizational units as they seek to fulfill the goals of their institution.

To create a data base one first examines the processes required to perform the task at hand. The business of higher education consists, at a minimum, of educating students. To educate a student you must first find him or her, then admit, then register, then bill, then teach, then evaluate, and so forth. Each of these steps is part of a flow. Each has data requirements, but the data flow with the process. They should not be kept in separate, isolated domains. In addition, whatever the source of the data, they are controlled for quality and integrity and are documented so that no misconceptions about meanings can arise.

Reporting need not be tied to collection and storage of data. (Appleton, 1977). Once appropriate input controls are established, then the data can be freely accessible by any unit which needs them to perform that units portion of the overall task.

While, in theory, there are distinct styles of governance, in reality most institutions display some of the characteristics of both the management and the administrative models. A data base system design lends itself to any form of governance thru the separation of the collection and reporting function. The managed areas of the institution can specify management information as output. Those that are administered can be served from some of the same data thru "user-friendly" query languages. Reporting can be application oriented, in that each unit of the organization requires only a subset of the entire data base. A faculty member requires information about students but not necessarily about colleagues. Payroll needs information about employees but rarely about purchasing contracts. A data base system can be designed to provide this differentiation.

Between input and output is storage, processing and control. This is the heart of the data base system. It is this portion of the system which reacts to changes and additions to the overall data needs of the institution. It is here that efficiency is monitored, that security is controlled.

Converting From An Application to a Data Base System

Every established institution has an information system--it could not operate without one. The goal of information systems management is to make that system more consistent, more efficient, and more informative. For the reasons stated above, one good way to do so is to convert to a data base philosophy. This is a three step process. The existing systems must first be analyzed from an overall perspective, appropriate changes must then be implemented, and finally, ongoing controls established.

The first task is to identify existing subsystems and to establish priorities for analysis. There is usually at least one outstandingly bad system (if there were no bad systems the institution wouldn't be going thru this exercise). This is an excellent place to start. On the other hand, if all systems are equally inefficient, then begin at the beginning, with the student admissions-registration-records chain.

The actual analysis consists of identifying the "information flow paths" (Toombs and Sagaria, 1978, p.3). This is done by locating the individuals responsible for maintaining the data, examining input forms, identifying the files they feed, inventorying data elements and working with those responsible to arrive at standard narrative definitions of the elements and translations of the codes. As an aid in identifying the content of data fields in the files at the University of South Florida, the SAS language was used to produce frequency distributions of each field. This uncovered unused or blank fields, displayed coding structures, and showed how the data actually appeared in the files. It also uncovered numerous coding errors which the users were then able to track

down and correct. Assigning keywords to identify files during this process, and associating each element with all its files helps to identify networks, relations or subschemas for a data base structure. It may be necessary in some cases to analyze the programs which create and alter files to identify data relationships.

The outcome of this process is a data element dictionary, which can be either manual or computerized. Figure 1 is a file description and figure 2 a data definition page from the University of South Florida Data Dictionary/ Directory. This is a manual document organized around existing multiple file systems. Figure 3 is a forms analysis (after Toombs and Sagaria, 1978, p.22) for Student Records.

The final step in analysing existing systems is to inventory reports and to link data elements to reports.

The above ex post facto systems analysis is needed in an environment with poor documentation. If existing documentation is adequate the scrutiny of forms, files and programs may be less extensive.

Once the system is analyzed, suggestions for improvements follow. Applications data files often contain large amounts of blank space for unmaintained data, or for expansion. Even before adopting a data base, files can be compressed by dropping unnecessary fields or by converting to more efficient file formats. Under a data base structure, fields can be added without affecting existing programs.[1] Other improvements include simplifying the programming of systems which have been patched together over a number of years, adding input edits to validate codes, eliminating duplicate coding structures, and implementing documentation standards to enhance maintainability.

The above analysis lays the ground work for an orderly, gradual conversion to a data base management systems (DBMS). The DBMS, together with internal historical data and external environmental information make up the

data portion of an information system.

Information Systems Management Tasks

Whether the information system relies on a data base or simply a conglomeration of files, programs, and resource materials, there are certain tasks which must be performed to allow it to operate effectively. These involve the coordination of the activities of many people including the operationsl staff who collect and feed the data into the system, the computing professionals who maintain it, and the administrators and staff who require access to the data. Efficiency demands that uniform standards be applied across all data systems.

1. Input Controls

a. Forms design coordination. At this point data names and field sizes can be standardized most easily. In addition, good human engineering principles need to be applied to both capture the information correctly and to set it up for easy data entry.

b. Input mode coordination. Decisions need to be made concerning the appropriateness of batch versus interactive processing and the advisability of providing pre-processors for certain applications, e.g., on-line registration, to moderate demand on the central processing unit.

c. Transaction standardization. If similar transaction methodologies were applied across all systems, it would be easier to use clerical staff more flexibly, and would cut down on data entry errors and training time.

d. Input edit specification. When an operational area no longer "owns" the data, it is imperative that input edit criteria to control erroneous codes be added to the processing. The importance of each data element should be considered when deciding if every error must be caught. Some items may permit tolerances to be built into the system, others may require rejection of a transaction, while others may just require an edit error listing.

e. Coordination of responsiblity. Coordination between those who maintain the data and those who use them is essential. Someone must have overall responsibility for the data when they are shared by many users. Those who enter elements may not be the ones who need them and would normally pay little attention to validity without overall supervision.

2. Data Maintenance

a. Coordinate programming standards. Because of staffing and turnover problems, strict system design and programming procedures and standards need to be implemented. Improvements in programming techniques including software programming aides, should be sought and training in their use provided to the staff. Documentation methodologies to enhance system maintainability are needed. Programming is in a state of transition from a craft to a science. The sooner the scientific techniques are introduced, the sooner the information system will be able to respond to the demands for flexiblility and efficiency currently being made of it.

b. Maintain a Data Dictionary/Directory. The inventory provided by even a manual Data Dictionary will lead to elimination of redundancy and to establishment of data naming conventions and standards. The data dictionary is the first step toward implementing a DBMS.

c. Coordinate coding structures and table maintenance to eliminate duplication and maintain currency.

d. Coordinate schedules of resource use.

e. Set priorities for resourse use.

f. Monitor resource use and search for ways to increase efficiency.

g. Coordinate periodic audits of data files for accuracy and validity. Audit procedures are needed for both student and staff data.

h. Coordinate access and update security.

i. Coordinate the specification of data base relationships when a data base management system is installed.

3. Data Access

a. Facilitate user access. Provide coordination among computer staff and users. A constant effort should be made to educate and to involve the users. Active computer user committees are excellent examples of the kind of coordination required. Knowledgeable direction and leadership of these committees enhance their effectiveness.

In addition, user-friendly query languages and terminals should be installed wherever feasible to reduce the demand on central computer programming staff for reports.

b. Provide management information. Collect and store environmental and historical information for use in planning and develop expertise in the use of statistical techniques, surveys and models.

c. Output mode coordination. Decisions need to be made concerning the appropriateness of batch versus on-line reporting, and concerning use of paper versus microfiche.

d. Coordinate report priorities.

Institutional Research and Information Systems Management

From the description above it can be inferred that information systems management fits Sheehan's three hat model of institutional research quite well. (Sheehan, 1975). The technical aspect is made up of two parts computer technician and one part statistician. The analyst is there in full force to conceptualize the relationships between the organization and the data base

model which reflects it. As Mann (1978) observes:

> Institutional Research has also been found to function well as a front-end analytical group for Information Systems. Although this role is not always appropriate, we have found that the Institutional Research staff can make excellent analysts to translate practical needs of certain operating offices into systematic set of requirements necessary for defining an overall computer application. Specifically, in the area of conceptual analysis and design, consistent with the data reporting needs of the user office, Institutional Research has been able to go into more depth in procedural analyses than Information Systems staff can usually afford to provide. (pp.2-3)

The perspective of the decision-maker is imperative. The information system must be compatible with the decision process, whatever form it may take, but even more importantly, the responsibility for the tasks for maintaining the system transcend organizational structure and must be addressed at the executive level of the institution.

Rice (1979) recommends that "Colleges would be well advised to consider employing a trained full time institutional researcher to design and maintain a centralized MIS information clearinghouse." (p. 75). In many institutions such positions have already been established either in the office of Institutional Research or under the broader aegis of an Office of Information Systems (Donald, 1979, Mann, 1978, Penrod and Craft, 1978).

The information systems manager could easily take on the role of Goodrich's "link man (or woman)" in the collegial decision process (1971, p.67) by serving as resource person on multiple policy committees. In a management environment, the information systems manager could be one of Glenney's "anonymous leaders" (1971), p. 8), or even a not so anonymous Vice President

for Planning and Information Systems (Mann, 1978). The roots of the role, however, are firmly grounded in institutional research and the opportunity is there to bring some order out of the chaos.

FILE FORMAT
ADMISSIONS SYSTEM

BASIC (B) RECORD: Keyword SAADCBASIC

FIELD ID	ELEMENT NAME	ELEMENT OBJ #	BEG/END POSITION		COBOL LEVEL AND DATA NAME	COBOL PICTURE	MARK IV NAME
25	Permanent Zip	U0070	174	178	03 ZIP	x(5)	
26	Permanent Telephone	U0071	179	188	03 PHONE	x(10)	
27			189	189	03 RELATION	x(1)	
28			190	254	02 S-PERM-ADDR		
29	Current Street Address	U0074	190	219	03 STREET-NR	x(30)	
30	Current City & State	U0075	220	239	03 CITY-STATE	x(20)	
31	Current Zip Code	U0076	240	244	03 ZIP	x(5)	
32	Permanent Telephone Number	U0077	245	254	03 PHONE	x(10)	
33			255	255	02 S-SUSPENSE	x(1)	
34	County of Residence	S1055	256	259	02 S-COUNTY-CDE	x(4)	
35	State (of Residence)	S1111	260	261	02 S-STATE-CDE	x(2)	
36			262	340	02 S-TEST-SCORES		
37	FLD 37		262	280	03 S-FLA-12-GRADE	x(19)	
38	Scholastic Aptitude Test (SAT)	U0090	281	290	03 S-COL-BD-SAT		
39	SAT-Verbal	U0091	281	283	04 V	x(3)	
40	SAT-Quantitative	U0092	284	286	04 Q	x(3)	
41	SAT-Date (MO/YR)	U0093	287	289	04 MON & 04 YR	x(4)	
42	FLD 42		291	307	03 S-SCAT	x(17)	
43	Graduate Test Information	U0103	308	319	03 S-GRAD-TEST		
44	Graduate Test Code	U0104	308	308	04 S-TEST-CDE	x(1)	
45	Graduate Test Verbal	U0105	309	312	04 V	x(4)	
46	Graduate Test Quantitative	U0106	313	315	04 Q	x(3)	
47	Graduate Test Date (MO/YR)	U0107	316	319	04 MON & 04 YR	x(4)	
48	FLD 48		320	324	03 S-GRE-ADVANCED	x(5)	

Figure 1
14

UNIVERSITY OF SOUTH FLORIDA
Office of Institutional Research

RUN DATE: 2/1/80 DATA DICTIONARY/DIRECTORY U0027-01

NAME:

Last Institution Code USF

KEYWORDS:

SAADCADMIS
SAADCSTATS

ITEM TYPE:

Element

NUMBER:

U0027

DEFINITION:

USF Code to indicate last institution attended.

EDIT:

CODING:

If it exists, the FICE code for the institution is used.
Otherwise, appropriate USF high school or post secondary school code is used.

TABLE VALUES:

FICE Code Reference - Education Directory, Colleges and Universities, National Center for Educational Statistics.
See table T0001 for USF Codes of high schools, foreign institutions and other institutions not in the Directory.

COMPONENTS:

PHYSICAL DESCRIPTION:

5 Alphanumeric

SOURCE:

ALTERNATE ITEM:

Last Institution Code (SUS) S1067
Last Institution Old USF Code U0116

Figure 2

CREATE-CHANGE DATE: 01/29/80

Analysis of Student Data Forms Comprehensive List of Information Items	Forms											
Element		Registration Course Request	Regular Registration Form	Late Staff/Workshop Registration Form	Non degree seeking Registration	Medical Student Enrollment Form	Continuing Education Enrollment Form	Social Security Number Correction	Change of Address	Change of Name	Undergrad Change of Curriculum	
Name	Number											
Name	U0001	O	O	X	X	O	O	O	O	C	O	
Social Security No.	S1029	X	X	X	X	X	X	X	X	X	X	
Classification	U0328	O	O	X	X	X	X					
Term /Quarter	U0049	O	O	X	X		X					
Current or Local Address	U0073	O	O	X	X	X	X	O	C	O		
Current or Local Phone	U0518	O	O	X	X	X	X	O	C			
Permanent Address	U0066	O	O	X	X	X	X		C			
Permanent Phone	U0077		O	X								
Emergency Name	U0303	O	O	X	X	O	X					
Emergency Address	U0301	O	O	X	X	O	X					
Emergency Phone	U0307	O	O	X	X	O	X					
Emergency Relation	U0302	O	O	X	X	O	X					
Permit Course Approval	-	O	O									
SCT Reference #	U0460	X	X	X	X	X	X					
Course ID (Pref No Sect)	S1195	O	O	O	O	O	O					
Crse credit	U0469	X	X	X	X	X	X					
Priority	-	X										
Alt Crse Sct Ref	U0484	X										
Alt Crse ID	U0478	O										
Alt Crse Credit (Variable)	-	X										
Dual Enroll Code	U0380	X	X	X	X	X	X					
Teacher	-	X	X	X	O	X	X					
Total Hrs	-	O	O									
Date	U0459	O	X	X	O	X	X	O	O	O		
(College rep) (Instructor) Advisor's approval	-	O	O	O	O		O					
Overload (18+) approval	-	O	O									
Audit Code	-		X	X			X					
Period & Day	U0506/U0489		O									
Building & Room	U0501		O									
On Campus Hours	-		O									
Non-Credit Courses	-		O									
Total Chargeable Hours	-		O									

Legend C - Keyed only if changed
X - Keyed wherever it appears
O - Not Keyed

Figure 3

FOOTNOTES

1. Of course, existing programs must be converted to the data base structure in the first place. There are data base management systems that allow gradual conversion of existing programs, and this is one of the features to look for when shopping for DBMS.

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